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PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(72) Inventor JOSEPH GUY ENOCK

(54) IMPROVEMENTS IN OR RELATING TO ELECTRO-ACOUSTIC TRANSDUCERS

(71) We, DECCA LIMITED, a British Company, of Decca House, 9 Albert Embankment, London, SE1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electro-acoustic transducers, including both microphones and loudspeakers, of the electrostatic type. It is more particularly directed to transducers of the kind having at least one transducing capacitor formed by a rigid perforated conductive plate spaced from a diaphragm comprising a sheet of non-conductive dielectric material (such as polyethylene terephthalate) having on its surface remote from the perforated plate a conductive film, the transducer, in use, being arranged to that a D.C. polarizing potential is applied between the plate and the conductive film. In the case of a loudspeaker, the electrical signal is also applied between the plate and conductive film whilst, in the case of a microphone, the electrical output is taken from across the plate and conductive film. Such transducers will hereinafter be referred to as transducers of the kind described.

The polarizing voltage and the applied electric signal produce respectively primary and secondary charges on the dielectric material. Transducers of the kind described tend to suffer from the disadvantage that the dielectric sheet of the diaphragm may acquire a tertiary charge which opposes that provided by the applied D.C. polarizing voltage, thus reducing the transducer sensitivity. This effect depends on the material employed. We have found experimentally that a layer of non-conductive dielectric material attached to the fixed perforated plate will provide an increase in the active polarization potential and so increase the sensitivity of the transducer.

Thus according to the present invention there is provided a transducer having at least one transducing capacitor formed by a rigid perforated conductive plate spaced from a diaphragm comprising a sheet of non-conductive dielectric material having on its surface remote from the perforated plate a conductive film, the perforated plate having on its surface nearer the diaphragm a layer of non-conductive material with perforations aligned with those in the plate. The increase in non-conductive dielectric material of the transducing capacitor adds no weight to the vibrating diaphragm which would be detrimental to the transducer efficiency and frequency response characteristics. The layer of non-conductive dielectric material on the plate is perforated as it it must not obstruct the transmission of acoustic energy through the plate.

The non-conductive dielectric material on the perforated plate may be the same material as is employed in the diaphragm and conveniently the material on the plate and in the diaphragm is polyethylene terephthalate.

The invention is applicable to transducers, particularly loudspeakers, of the push-pull type. In one arrangement with a single diaphragm between two perforated plates, each perforated plate, on the surface nearer the diaphragm, has a layer of non-conductive dielectric material with perforations aligned with those in the plate. Alternatively a single perforated plate may be arranged between two diaphragms and, in this case, the perforated plate has a layer of non-conductive dielectric material on each surface, each layer having perforations aligned with those in the plate.

In the following description, reference will be made to the accompanying drawing in which:

Figure 1 is an exploded view of a transducer unit for a loudspeaker;

Figure 2 is a perspective view of an assembled unit as shown in Figure 1;

Figure 3 is a section through part of a unit of Figures 1 and 2;

Figure 4 is a diagrammatic perspective view illustrating how the units of Figures 1, 2 and 3 can be assembled to form a loudspeaker; and

Figures 5 and 6 are sections through parts of two different forms of push-pull transducer units.

[Price 25p]

Referring to Figures 1 to 3, the transducer has a diaphragm consisting of a thin membrane 10 of dielectric material, conveniently polyethylene terephthalate sheet coated on the outside with a conductive layer 11. A spacer 12 of rectangular form spaces the diaphragm away from a dielectric sheet 13 on a perforated metal plate 14. The spacer 12 might be arranged between the membrane 10 and the dielectric sheet 13 but, in the particular construction illustrated, the spacer is formed by a raised rim around and integral with the perforated plate 14, the sheet 13 being of such size as to fit within the rim. The spacer 12 ensures the spacing of the sheets 10, 13 leaving the central part of the diaphragm free to vibrate. The sheet 13 is also conveniently made of polyethylene terephthalate. It must not obstruct the perforations in the plate 14. Conveniently in constructing the transducer, a continuous sheet of the dielectric 13 is put on the central part of the metal plate within the raised rim and then, by means of a flame against the plate, the obstructions across the perforations are destroyed. Alternatively the dielectric sheet 13 is formed by applying the material as a coating on the metal plate, thereby inherently avoiding obstruction of the perforations in the plate.

The transducer elements thus far described are assembled together to form a transducer unit as shown in Figure 2. This unit is of square or rectangular form. The units are small (about 3 ins square) in order to maintain a thin uniform air spacing between the diaphragm 10 and sheet 13 and to provide the desired tension in the diaphragm. To produce the required radiating surface for a loudspeaker, an array of such units are assembled together as shown in Figure 4, one transducer unit being indicated by the shaded square 16. Although in Figure 4, the transducers are shown as assembled in a flat plane, it may be preferred to arrange them in a curved plane or planes shaped to give required directional radiation of the sound.

Referring to Figure 3, a D.C. polarizing potential is applied between the conductive coating 11 and the metal plate 14 by means of a high voltage source represented diagrammatically by a battery 20 in series with a resistor 21 providing a safety protection against any appreciable current flowing. The audio signals at input terminals 22 are applied through a transformer 23 and coupling capacitor 24.

Figure 5 illustrates a transducer unit for a push-pull loudspeaker in which a diaphragm is formed of two sheets 30, 31 of polyethylene terephthalate sandwiching a conductive layer 32. Two rigid perforated metal plates 33, 34 are spaced from the diaphragm on either side thereof by spacing means shown as raised rims similar to that employed in the unit of Figures 1 to 3. The plates 33, 34 have perforated sheets 35, 36, also of polyethylene terephthalate on their inner surfaces. In Figure 5, the polarizing voltage from a high voltage source 37 is applied through resistors 38 to the two metal plates 33, 34 to maintain these at a positive potential with respect to the conductive layer 32. The audio signals are applied via a transformer 39 and coupling capacitors 40.

An alternative form of push-pull transducer unit is shown in Figure 6. A single perforated metal plate 45 has, on its two surfaces, perforated polyethylene terephthalate sheets 46, 47. Spaced from these two sheets 46, 47 are respectively two diaphragms each consisting of a polyethylene terephthalate sheet 48 and conductive layer 49. An alternative manner of applying the signals to the transducer is shown in Figure 6 which avoids the use of the capacitors and resistors used in the arrangement of Figure 5. In Figure 6, a high voltage source 50 shown here as a battery provides the polarizing voltage. The audio signals are applied via a transformer 51.

In the drawings, in order to make clear the construction, the thickness of the various elements has been greatly exaggerated. In practice, typical dimensions for the metal plates, such as plate 14, or plates 33, 34, might be 3 inches square and less than 0.01 inches thick. The diaphragm 10 might be 0.001 inches thick and the sheet 13 might be 0.0005 inches thick.

WHAT WE CLAIM IS:—

1. A transducer having at least one transducing capacitor formed by a rigid perforated conductive plate spaced from a diaphragm comprising a sheet of non-conductive dielectric material having a conductive film only on its surface remote from the perforated plate, the perforated plate having on its surface nearer the diaphragm a layer of non-conductive dielectric material with perforations aligned with those in the plate.

2. A transducer as claimed in claim 1 wherein the non-conductive dielectric material on the perforated plate is of the same material as is employed in the diaphragm.

3. A transducer as claimed in either claim 1 or claim 2 in which the non-conductive dielectric material on the perforated plate is such as will provide an increase in the active polarization potential when a D.C. polarizing voltage is applied between the perforated plate and the conductive film.

4. A transducer as claimed in any one of claims 1 to 3 wherein the non-conductive dielectric material on the plate and in the diaphragm is polyethylene terephthalate.

5. A transducer as claimed in any of the preceding claims wherein, to space the

diaphragm from the perforated plate, a spacer or a raised portion of the plate is provided between the peripheral region of the diaphragm and the perforated plate.

6. A transducer as claimed in any of the preceding claims and arranged for push-pull operation wherein a single diaphragm is arranged between two perforated plates, each perforated plate, on the surface nearer the diaphragm, having a layer of non-conductive dielectric material with perforations aligned with those in the plate.

7. A transducer as claimed in any of claims 1 to 5 and arranged for push-pull operation wherein a single perforated plate is arranged between two diaphragms, the perforated plate having a layer of non-conductive dielectric material on each surface, each layer having perforations aligned with those in the plate.

8. A transducer assembly comprising an array of transducers, each transducer being as claimed in any of the preceding claims and of square or rectangular form, the transducers being arranged in a flat or curved plane or planes.

9. A transducer substantially as hereinbefore described with reference to Figures 1, 2 and 3 or to Figures 1, 2, 3 and 4 or to Figures 5 or Figure 6 of the accompanying drawings.

BOULT, WADE & TENNANT,
111 and 112 Hatton Garden,
London, E.C.1,
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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig.1.

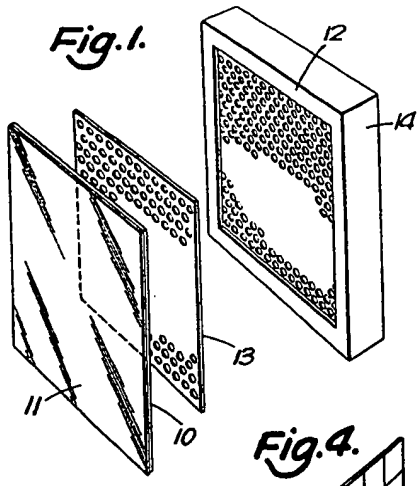

Fig.2.

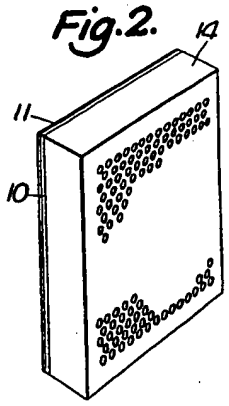

Fig.3.

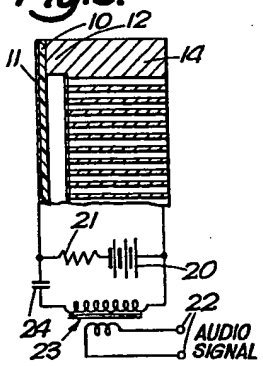

Fig.4.

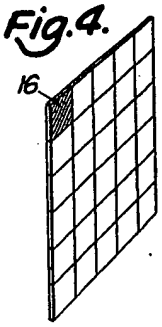

Fig.5.

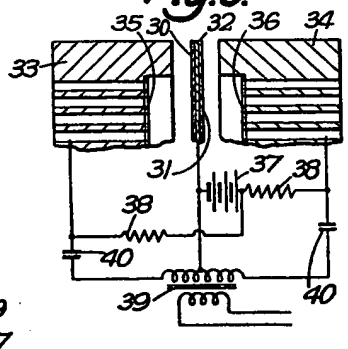

Fig.6.